SUMMARY

[0005] According to the disclosure, a coated article is provided. The coated article comprises a substrate, a first functional layer over at least a portion of the substrate, and a protective coating over at least a portion of the functional layer, wherein an uppermost layer of the functional layer is a metal oxide film, and wherein the protective coating comprises one or more layers of a metal nitride, a metal oxynitride, or a combination thereof.

[0006] In one example, the coated article comprises: a glass substrate; a first layer of zinc stannate over at least a portion of the glass substrate; a layer of zinc oxide over at least a portion of the layer of zinc stannate; a layer of silver over at least a portion of the layer of zinc oxide; a primer layer comprising Ti, TiAl and/or oxides thereof over at least a portion of the layer of silver; a second layer of zinc stannate over at least a portion of the primer layer; a metal oxynitride layer comprising silicon oxynitride directly over at least a portion of the second layer of zinc stannate; a metal nitride layer comprising silicon directly over at least a portion of the metal oxynitride layer; and a second protective layer comprising Ti, TiAl, and/or oxides of either of the preceding over at least a portion of the metal nitride layer.

[0007] In another example, a coated article is provided. The coated article comprises a substrate, a functional layer, having an uppermost layer, over at least a portion of the substrate, and a protective coating over at least a portion of the functional layer, wherein the uppermost layer of the functional layer is a dielectric layer having an index of refraction of at least 1.5, and not more than 2.1.

[0008] In another example, a coated article is provided comprising a substrate, a functional layer over at least a portion of the substrate, and a protective coating over at least a portion of the functional layer, wherein the functional layer comprises at least one metallic layer and a primer layer disposed at least partially over and in contact with at least part of the at least one metallic layer, and wherein an uppermost layer of the functional layer is disposed over and in contact with at least part of the primer layer, and the uppermost layer of the functional layer does not include zinc oxide.

[0008a] In one aspect, the present disclosure provides a coated article comprising:

a substrate;

a first functional layer over at least a portion of the substrate, the first functional layer comprising a silver layer over at least a portion of the substrate and an uppermost layer comprising a metal oxide over at least a portion of the silver layer;

a metal oxynitride layer comprising silicon directly over at least a portion of the uppermost layer comprising a metal oxide;

a metal nitride layer comprising silicon over at least a portion of the metal oxynitride layer; and

a protective layer comprising TiAlO over at least a portion of the metal oxynitride layer.

[0008b] In another aspect, the present disclosure provides a coated article, comprising:

a glass substrate;

a first layer of zinc stannate directly over at least a portion of the glass substrate;

a layer of zinc oxide directly over at least a portion of the layer of zinc stannate;

a layer of silver directly over at least a portion of the layer of zinc oxide;

a primer layer comprising Ti, TiAl, and/or oxides of either of the preceding directly over at least a portion of the layer of silver;

a second layer of zinc stannate directly over at least a portion of the primer layer;

a metal oxynitride layer comprising silicon directly over at least a portion of the second layer of zinc stannate;

a metal nitride layer comprising silicon directly over at least a portion of the metal oxynitride layer; and

a protective layer comprising TiAlO directly over at least a portion of the metal nitride layer.

[0008c] In another aspect, the present disclosure provides a coated article, comprising:

a glass substrate;

a first layer of zinc stannate over at least a portion of the glass substrate and having a thickness ranging from 250 Å to 400 Å;

a layer of zinc oxide over at least a portion of the layer of zinc stannate and having a thickness ranging from 70 Å to 90 Å;

a layer of silver over at least a portion of the layer of zinc oxide and having a thickness ranging from 70 Å to 90 Å;

a primer layer comprising Ti over at least a portion of the layer of silver and having a thickness ranging from 10 Å to 30 Å;

a second layer of zinc stannate over at least a portion of the primer layer and having a thickness ranging from 30 Å to 100 Å;

a metal oxynitride layer comprising SiON directly over at least a portion of the second layer of zinc stannate and having a thickness ranging from 70 Å to 400 Å;

a metal nitride layer comprising SiN directly over at least a portion of the metal oxynitride layer and having a thickness ranging from 100 Å to 400 Å; and

a protective layer comprising TiAlO over the metal nitride layer and having a thickness ranging from 100 Å to 400 Å.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention will be described with reference to the following drawing figures wherein like reference numbers identify like parts throughout.

WHAT IS CLAIMED IS:

1. A coated article comprising:

a substrate;

a first functional layer over at least a portion of the substrate, the first functional layer comprising a silver layer over at least a portion of the substrate and an uppermost layer comprising a metal oxide over at least a portion of the silver layer;

a metal oxynitride layer comprising silicon directly over at least a portion of the uppermost layer comprising a metal oxide;

a metal nitride layer comprising silicon over at least a portion of the metal oxynitride layer; and

a protective layer comprising TiAlO over at least a portion of the metal oxynitride layer.

2. The coated article of claim 1, wherein the metal oxynitride layer comprising silicon is a gradient layer in which the portion of the metal oxynitride layer closest to the uppermost layer of the first functional layer comprises a greater amount of oxygen than the portion of the metal oxynitride layer closest to the metal nitride layer.

3. The coated article of claim 1 or 2, wherein the uppermost layer of the first functional layer comprises zinc stannate.

4. The coated article of any one of claims 1 to 3, wherein the first functional layer comprises a dielectric layer over at least a portion of the substrate and the silver layer over at least a portion of the dielectric layer.

5. The coated article of claim 4, wherein the first functional layer further comprises a primer layer over at least a portion of the silver layer and under at least a portion of the uppermost layer.

6. The coated article of claim 5, wherein the primer layer comprises titanium, or titanium and aluminum.

7. The coated article of claim 6, wherein at least a portion of the titanium, or titanium and aluminum are oxidized after the titanium or titanium and aluminum are deposited over the silver layer.

8. The coated article of any one of claims 5 to 7, wherein the dielectric layer comprises one or more layers comprising zinc oxide and/or zinc stannate and/or the uppermost layer comprises zinc oxide and/or zinc stannate.

9. The coated article of any one of claims 1 to 7, wherein the uppermost layer of the functional layer does not comprise zinc oxide.

10. The coated article of any one of claims 1 to 9, further comprising a second functional layer beneath at least a portion of the first functional layer and over at least a portion of the substrate.

11. The coated article of any one of claims 1 to 10, wherein the metal nitride layer is directly over the metal oxynitride layer.

12. The coated article of any one of claims 1 to 11, mounted in a body of a vehicle or an insulating glass unit.

13. A coated article, comprising:

a glass substrate;

a first layer of zinc stannate directly over at least a portion of the glass substrate;

a layer of zinc oxide directly over at least a portion of the layer of zinc stannate;

a layer of silver directly over at least a portion of the layer of zinc oxide;

a primer layer comprising Ti, TiAl, and/or oxides of either of the preceding directly over at least a portion of the layer of silver;

a second layer of zinc stannate directly over at least a portion of the primer layer;

a metal oxynitride layer comprising silicon directly over at least a portion of the second layer of zinc stannate;

a metal nitride layer comprising silicon directly over at least a portion of the metal oxynitride layer; and

a protective layer comprising TiAlO directly over at least a portion of the metal nitride layer.

14. A coated article, comprising:

a glass substrate;

a first layer of zinc stannate over at least a portion of the glass substrate and having a thickness ranging from 250 Å to 400 Å;

a layer of zinc oxide over at least a portion of the layer of zinc stannate and having a thickness ranging from 70 Å to 90 Å;

a layer of silver over at least a portion of the layer of zinc oxide and having a thickness ranging from 70 Å to 90 Å;

a primer layer comprising Ti over at least a portion of the layer of silver and having a thickness ranging from 10 Å to 30 Å;

a second layer of zinc stannate over at least a portion of the primer layer and having a thickness ranging from 30 Å to 100 Å;

a metal oxynitride layer comprising SiON directly over at least a portion of the second layer of zinc stannate and having a thickness ranging from 70 Å to 400 Å;

a metal nitride layer comprising SiN directly over at least a portion of the metal oxynitride layer and having a thickness ranging from 100 Å to 400 Å; and

a protective layer comprising TiAlO over the metal nitride layer and having a thickness ranging from 100 Å to 400 Å.